

ITEM P-620 RUNWAY AND TAXIWAY PAINTING

DESCRIPTION

620-1.1 This item shall consist of the painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the Engineer.

MATERIALS

620-2.1 MATERIALS ACCEPTANCE. The Contractor shall furnish manufacturer's certified test reports for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. The reports can be used for material acceptance or the Engineer may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the Engineer upon arrival of a shipment of materials to the site. The material quantities shall be verified "on-site" to match the square feet of markings. Quantities shall be calculated in accordance with the coverage rates outlined below for both paint and glass beads.

620-2.2 PAINT. Paint shall be ~~[Waterborne, Epoxy, Methacrylate, or Solvent-base]~~ in accordance with the requirements of paragraph 620-2.2[a]. Paint shall be furnished in [White - 37925, Yellow - 33538 or 33655, ~~Pink - 1 part Red - 31136 to 2 parts White - 37925~~, Red - 31136 and Black - 37038] in accordance with Federal Standard No. 595.

a. WATERBORNE. Paint shall meet the requirements of Federal Specification TT-P-1952E. ~~[Type I, Type II, or Type III].~~ Waterborne black paint shall be used to outline a border at least 6-inches (150 mm) wide around markings on all light colored pavements.

~~**b. EPOXY.** Paint shall be a two component, minimum 99 percent solids type system conforming to the following:~~

~~**(1) Pigments.** Component A. Percent by weight.~~

~~**(a) White:** Titanium Dioxide, ASTM D 476, type II shall be 18 percent minimum (16.5 percent minimum at 100 percent purity).~~

~~**(b) Yellow and Colors:** Titanium Dioxide, ASTM D 476, type II shall be 14 to 17 percent. Organic yellow, other colors, and tinting as required to meet color standard. Epoxy resin shall be 75 to 79 percent.~~

~~**(2) Epoxy Content.** Component A. The weight per epoxy equivalent, when tested in accordance with ASTM D 1652 shall be the manufacturer's target plus or minus 50.~~

~~**(3) Amine Number.** Component B. When tested in accordance with ASTM D 2074 shall be the manufacturer's target plus or minus 50.~~

~~**(4) Prohibited Materials.** The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen, as defined in 29 CFR 1910.1200.~~

~~**(5) Daylight Directional Reflectance:**~~

~~**(a) White:** The daylight directional reflectance of the white paint shall not be less than 75 percent (relative to magnesium oxide), when tested in accordance with Federal Test Method Standard No. 141D/GEN, Method 6121.~~

~~(b) Yellow:~~ The daylight directional reflectance of the yellow paint shall not be less than 38 percent (relative to magnesium oxide), when tested in accordance with Federal Test Method Standard No. 141D/GEN. The x and y values shall be consistent with the Federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

~~x .462 x .470 x .479 x .504
y .438 y .455 y .428 y .452~~

~~(6) Accelerated Weathering.~~

~~(a) Sample Preparation.~~ Apply the paint at a wet film thickness of 0.013 inch (0.33 mm) to four 3 by 6 inch (8 by 15 cm) aluminum panels prepared as described in Federal Test Method Standard No. 141D/GEN, Method 2013. Air dry the sample 48 hours under standard conditions.

~~(b) Testing Conditions.~~ Test in accordance with ASTM G 154 using both Ultra Violet (UV-B) Light and condensate exposure, 72 hours total, alternating 4 hour UV exposure at 60 degree C, and 4 hours condensate exposure at 40 degrees C.

~~(c) Evaluation.~~ Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in paragraph 620-2.2b(5) above. Evaluate for conformance with the color requirements.

~~(7) Volatile Organic Content.~~ Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

~~(8) Dry Opacity.~~ Use Procedure B, Method B of Method 4121 of Federal Test Method Standard No. 141D/GEN. The wet film thickness shall be 0.015 inch (0.12 mm). The minimum opacity for white and colors shall be 0.92.

~~(9) Abrasion Resistance.~~ Subject the panels prepared in paragraph 620-2.2b(6) to the abrasion test in accordance with ASTM D 968, Method A, except that the inside diameter of the metal guide tube shall be from 0.747 to 0.750 inch (18.97 to 19.05 mm). Five liters of unused sand shall be used for each test panel. The test shall be run on two test panels. [Note: five liters of sand weighs 17.5 lb. (7.94 kg).] Both baked and weathered paint films shall require not less than 150 liters of sand for the removal of the paint films.

~~(10) Hardness, Shore.~~ Hardness shall be at least 80 when tested in accordance with ASTM D 2240.

~~c. METHACRYLATE.~~ Paint shall be a two component, minimum 99 percent solids type system conforming to the following:

~~(1) Pigments.~~ Component A. Percent by weight.

~~(a) White:~~ Titanium Dioxide, ASTM D 476, type II shall be 6 percent minimum. Methacrylate resin shall be 18 percent minimum.

~~(b) Yellow and Colors:~~ Titanium Dioxide, ASTM D 476, type II shall be 6 percent minimum. Organic yellow, other colors, and tinting as required to meet color standard. Methacrylate resin shall be 18 percent minimum.

~~(2) Prohibited Materials.~~ The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen, as defined in 29 CFR 1910.1200.

(3) Daylight Directional Reflectance:

~~(a) White:~~ The daylight directional reflectance of the white paint shall not be less than 80 percent (relative to magnesium oxide), when tested in accordance with Federal Test Method Standard No. 141D/GEN, Method 6121.

~~(b) Yellow:~~ The daylight directional reflectance of the yellow paint shall not be less than 55 percent (relative to magnesium oxide), when tested in accordance with Federal Test Method Standard No. 141D/GEN. The x and y values shall be consistent with the Federal Hgman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

~~x .462 x .470 x .479 x .501
y .438 y .455 y .428 y .452~~

(4) Accelerated Weathering.

~~(a) Sample Preparation.~~ Apply the paint at a wet film thickness of 0.013 inch (0.33 mm) to four 3 by 6 inch (8 by 15 cm) aluminum panels prepared as described in Method 2013 of Federal Test Method Standard No. 141D/GEN. Air dry the sample 48 hours under standard conditions.

~~(b) Testing Conditions.~~ Test in accordance with ASTM G 154 using both Ultra Violet (UV-B) Light and condensate exposure, 72 hours total, alternating 4 hour UV exposure at 60 degree C, and 4 hours condensate exposure at 40 degrees C.

~~(c) Evaluation.~~ Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in paragraph 620-2.2c(3) above. Evaluate for conformance with the color requirements.

~~(5) Volatile Organic Content.~~ Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

~~(6) Dry Opacity.~~ Use Procedure B, Method B of Method 4121 of Federal Test Method Standard No. 141D/GEN. The wet film thickness shall be 0.015 inch (0.12 mm). The minimum opacity for white and colors shall be 0.92.

~~(7) Abrasion Resistance.~~ Subject the panels prepared in paragraph 620-2.2c(4) to the abrasion test in accordance with ASTM D 968, Method A, except that the inside diameter of the metal guide tube shall be from 0.747 to 0.750 inch (18.97 to 19.05 mm). Five liters of unused sand shall be used for each test panel. The test shall be run on two test panels. [Note: five liters of sand weighs 17.5 lb. (7.94 kg).] Both baked and weathered paint films shall require not less than 150 liters of sand for the removal of the paint films.

~~(8) Hardness, Shore.~~ Hardness shall be at least 80 when tested in accordance with ASTM D 2240.

d. SOLVENT BASE. Paint shall meet the requirements of Federal Specification **[A-A-2886A Type I or Type II]**.

620-2.3 REFLECTIVE MEDIA. Glass beads shall meet the requirements of Fed. Spec. TT-B-1325D, **[Type I gradation A, Type III, or Type IV]**. Glass beads shall be treated with all compatible coupling agents recommended by the manufacturers of the paint and reflective media to ensure adhesion and embedment adhesion promoting and/or flotation coatings. The Retroreflective readings at application

should meet values ranging from 700 to 1100 millicandellas on the white markings and 400 to 900 millicandellas on yellow markings.

CONSTRUCTION METHODS

620-3.1 WEATHER LIMITATIONS. The painting shall be performed only when the surface is dry and when the surface temperature is at least 45 degrees F (7 degrees C) and rising and the pavement surface temperature is at least 5 degrees F (2.7 degrees C) above the dew point. Painting operations shall be discontinued when the surface temperature exceeds the minimum or maximum temperatures recommended by the paint manufacturer. Markings shall not be applied when the pavement temperature is greater than 120 degrees F (48.9 degrees C).

620-3.2 EQUIPMENT. Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job. The equipment shall be able to paint from 6-inches to 36-inches in a single pass with the capability of applying two colors simultaneously.

The mechanical marker shall be an atomizing spray-type or airless type marking machine suitable for application of traffic paint. It shall produce an even and uniform film thickness at the required coverage and shall apply markings of uniform cross sections and clear-cut edges without running or spattering and without over spray.

620-3.3 PREPARATION OF SURFACE. Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other foreign material which would reduce the bond between the paint and the pavement. The area to be painted shall be cleaned by high pressure water blasting to remove all loose and poorly bonded paint, mildew or other surface contaminants. A vacuum sweeper shall be provided to remove the majority of the water and debris as the cleaning proceeds. The Engineer shall be given 24-hours notice prior to the commencement of painting operations to insure adequate cleaning measures have been performed ~~sweeping and blowing or by other methods as required to remove all dirt, laitance, and loose materials without damage to the pavement surface. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the Engineer.~~ Paint shall not be applied to Portland cement concrete pavement until the areas to be painted are clean of curing material. Sandblasting or high-pressure water shall be used to remove curing materials.

620-3.4 LAYOUT OF MARKINGS. The proposed markings shall be laid out in advance of the paint application. ~~The locations of markings to receive glass beads shall be shown on the plans.~~ Markings to be repainted shall be verified for proper location and alignment in accordance with the tolerances shown under 620-3.5 below. All markings shall receive glass beads unless otherwise noted on the plans.

620-3.5 APPLICATION. Paint shall be applied at the locations and to the dimensions and spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface have been approved by the Engineer. The edges of the markings shall not vary from a straight line more than 1/2-inch (12 mm) in 50-feet (15 m) and marking dimensions and spacings shall be within the following tolerances:

Dimension and Spacing	Tolerance
36-inches (910 mm) or less	+/- 1/2-inch (12 mm)
greater than 36-inches to 6-feet (910 mm to 1.85 m)	+/- 1-inch (25 mm)
greater than 6-feet to 60-feet (1.85 m to 18.3 m)	+/- 2-inches (51 mm)
greater than 60-feet (18.3 m)	+/- 3-inches (76 mm)

The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine at the rate(s) shown in Table 1. The addition of thinner will not be permitted. A period of **[30 days]** shall elapse between placement of a bituminous surface course or seal coat and application of the paint. If the runway must be placed in service before the 30-day cure time, markings shall be applied at 1/2 rate without glass beads. After the 30-day cure time, a full application of paint and beads shall be applied to all affected markings. If the airport requires beads be applied to the paint that was applied at 1/2 rate, the beads shall be applied at a rate that will produce Retroreflective readings at application that meet values ranging from [] to [] millicandellas on the white markings and [] to [] millicandellas on yellow markings. Once the asphalt pavements have cured and the pavement is ready for final full application of markings, all existing glass beads (if present) shall be swept clear of the temporary paint and the temporary paint prepared in accordance with these specifications to receive the full and final painting.

Paint installation shall be monitored for correct application rates (film thickness). Wet film thickness gauges shall be used in wet paint to ascertain the "wet film thickness" of the paint. The proper paint thickness is necessary to properly anchor the glass beads and verify the paint coverage matches the application rates below. Wet film thickness should be 15 mils wet.

TABLE 1. APPLICATION RATES FOR PAINT, GLASS BEADS, AND SILICA SAND

Paint Type	Paint Square feet per gallon, ft ² /gal (Square meters per liter, m ² /l)	Glass Beads, Type I, Gradation A Pounds per gallon of paint-- lb./gal (Kilograms per liter of paint-- kg/l)	Glass Beads, Type III Pounds per gallon of paint-- lb./gal. (Kilograms per liter of paint-- kg/l)	Glass Beads, Type IV Pounds per gallon of paint-- lb./gal. (Kilograms per liter of paint-- kg/l)
Waterborne	110 ft ² /gal. Maximum (2.8 m ² /l)	7 lb./gal. Minimum (0.85 kg/l)	10 lb./gal. Minimum (1.45 kg/l)	4 lb./gal. minimum (0.5 kg/l)
Waterborne	90 ft²/gal. Maximum (2.2 m²/l)	--	--	8 lb./gal. Minimum (1.0 kg/l)
Solvent Base	115 ft ² /gal. Maximum (2.8 m ² /l)	7 lb./gal. Minimum (0.85 kg/l)	10 lb./gal. Minimum (1.2 kg/l)	--
Solvent Base	90 ft²/gal. Maximum (2.2 m²/l)	--	--	8 lb./gal. Minimum (1.0 kg/l)
Epoxy	90 ft ² /gal. Maximum (2.2 m ² /l)	14 lb./gal. minimum (1.7 kg/l)	20 lb./gal. Minimum (2.4 kg/l)	15 lb./gal. Minimum (1.8 kg/l)
Methacrylate	45 ft ² /gal. Maximum (1.1 m ² /l)	14 lb./gal. Minimum (1.7 kg/l)	20 lb./gal. minimum (2.4 kg/l)	15 lb./gal. Minimum (1.8 kg/l)

Glass beads shall be distributed upon the marked areas at the locations shown on the plans to receive glass beads immediately after application of the paint. A dispenser shall be furnished which is properly

designed for attachment to the marking machine and suitable for dispensing glass beads as the paint is applied. Each bead dispenser shall be calibrated in the presence of the inspector or their designated representative in accordance with the manufacturer's recommendations. A calibration kit consisting of a scaled beaker and a stopwatch is available from the glass bead manufacturer. Glass beads shall be applied at the rate(s) shown in Table 1. Glass beads shall not be applied to black paint. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made.

Retro-Reflectivity readings measure the effective light return for glass beads and are correlated to low light or nighttime visibility. Retro-Reflective readings shall measure a minimum of 700 millicandellas per square meter per lux for white paint and a minimum of 400 for yellow paint. Readings shall be taken within three (3) days of application using an approved 30 meter retro-reflectometer (Miralux or LTL 2000).

All emptied containers shall be returned to the paint storage area for checking by the Engineer. The containers shall not be removed from the airport or destroyed until authorized by the Engineer.

620-3.6 PROTECTION AND CLEANUP. After application of the paint, all markings shall be protected from damage until the paint is dry. All surfaces shall be protected from excess moisture and/or rain and from disfiguration by spatter, splashes, spillage, or drippings of paint. The Contractor shall remove from the site all debris, waste, loose or unadhered reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the Engineer. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and Federal environmental statutes and regulations.

METHOD OF MEASUREMENT

620-4.1 The quantity of runway and taxiway markings and associated surface preparation to be paid for shall be **[the number of square feet (square meters) of painting and the number of pounds (kilograms) of reflective media] [one complete item in place]** performed in accordance with the specifications and accepted by the Engineer.

BASIS OF PAYMENT

620-5.1 Payment shall be made at the respective contract **[price per square foot (square meter)] [lump sum price]** for runway and taxiway painting and associated surface preparation and **[price per pound (kilogram)] [lump sum price]** for reflective media. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-620-5.1	Pavement Markings with Type III Reflective Beads Including Surface Preparation -- Per Square Foot (square meter) Square Foot
Item P-620-5.2	Runway and Taxiway Painting (Yellow) with Type III Reflective Beads Including Surface Preparation -- Per Square Foot (square meter) Square Foot
Item P-620-5.3	Runway and Taxiway Painting (Black Enhanced) without Reflective Beads Including Surface Preparation -- Per Square Foot (square meter) Square Foot
Item P-620-5.4	Surface Painted Runway Hold Position Signs -- Per Square Foot (square meter) each
Item P-620-5.5	Temporary Runway and Taxiway Painting without Reflective Beads Including Surface Preparation -- Per Square Foot (square meter)

TESTING REQUIREMENTS

ASTM C 136	Sieve Analysis of Fine and Coarse Aggregates
ASTM C 146	Chemical Analysis of Glass Sand
ASTM C 371	Wire-Cloth Sieve Analysis of Nonplastic Ceramic Powders
ASTM D 92	Test Method for Flash and Fire Points by Cleveland Open Cup
ASTM D 711	No-Pick-Up Time of Traffic Paint
ASTM D 968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1213-54 (1975)	Test Method for Crushing Resistance of Glass Spheres
ASTM D 1652	Test Method for Epoxy Content of Epoxy Resins
ASTM D 2074	Test Method for Total Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D 2240	Test Method for Rubber Products-Durometer Hardness
ASTM G 154	Operating Light and Water-Exposure Apparatus (Florescent Light Apparatus UV-Condensation Type) for Exposure of Nonmetallic Materials
Federal Test Method Standard No. 141D/GEN	Paint, Varnish, Lacquer and Related Materials; Methods of Inspection, Sampling and Testing

MATERIAL REQUIREMENTS

ASTM D 476	Specifications for Dry Pigmentary Titanium Dioxide Pigments Products
Code of Federal Regulations	40 CFR Part 60, Appendix A, Definition of Traverse Point Number and Location
Code of Federal Regulations	29 CFR Part 1910.1200 – Hazard Communications
Fed. Spec. TT-B-1325D	Beads (Glass Spheres) Retroreflective
AASHTO M 247	Glass Beads Used in Traffic Paints
Fed. Spec. TT-P-1952E	Paint, Traffic and Airfield Marking, Waterborne
Commercial Item Description (CID) A-A-2886B	Paint, Traffic, Solvent Based
Federal Standard 595	Colors used in Government Procurement

END OF ITEM P-620